Pictorial Review

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Ascites matters

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Abstract

The excess accumulation of intra-peritoneal fluid, referred to as ascites, is an important clue that points to a significant underlying illness. This may be due to a pathological event within the peritoneal cavity or secondary to an underlying systemic condition. Ascites is broadly classified into transudate and exudate, based on protein content, with a potential wide range of differential diagnoses. Traditionally, computed tomography has been regarded as the imaging modality of choice to demonstrate ascites and diagnose the underlying cause. However, ultrasound can reliably detect small volumes of fluid and is a useful first-line imaging modality for clinical triage. For instance, in the emergency setting, the detection of a trace of ascites may be the earliest indicator of an acute abdomen needing surgery. Ultrasound can quantify the volume of ascites and aid in the decision process for fluid drainage. Ultrasound is superior to computed tomography in the qualitative assessment of fluid. Broadly, simple fluid is anechoic, whereas complex fluid may appear particulate, layered or contain septations. On computed tomography, both have a uniform hypo-dense appearance and are often indistinguishable. Given ultrasound, in comparison to computed tomography, is safe, relatively inexpensive and readily available, it is a valuable tool in the assessment of ascites. Once ascites is detected on ultrasound, it is imperative for the operator to have a systematic approach to attempt to provide an underlying diagnosis. Through a series of cases, this article aims to increase awareness and reaffirm the role of ultrasound in the assessment of ascites.

Keywords

Ultrasound, ascites, peritoneum, free fluid

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Introduction

Ultrasound (US) of the abdomen and pelvis is a robust diagnostic tool that is considered to represent a highly accurate extension of the physical examination in the assessment of patients with abdominal signs and symptoms in both the emergency and outpatient setting. US is widely recognised for being a reliable, safe and reproducible modality in the evaluation of the solid intra-abdominal organs such as the liver, gallbladder, kidneys and reproductive organs.[1] However, it is perceived as having only a secondary role in the evaluation of ascites due to the over-reliance on computerised tomography (CT) and a belief that artefact from overlying bowel gas always limits detail.[1]

Most operators have a focused technique in distinguishing normal and pathological solid intra-abdominal organs; however, there is less structure and emphasis placed on the value of US in the detection and characterisation of ascites. The lack of understanding of the pathophysiology and clinical relevance may represent a missed opportunity to make the correct diagnosis and can potentially lead to a delayed diagnosis, which may result in unwanted morbidity and increased mortality.

Through a series of cases, this article highlights the value of US in the detection, quantification and characterisation of ascites. With a systematic approach, US can be used to assess the contents of the peritoneal cavity to make a diagnosis and accurately guide further management.

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Ascites

The peritoneal cavity normally contains approximately 50–75 mls of fluid that serves to lubricate the tissues that line the abdominal wall and viscera.[1,2] The term ascites is reserved to denote an abnormal accumulation of this fluid.[1,2]

Ascites is traditionally divided into transudate or exudate based on the protein content.[1] Transudates (protein < 25 g/L) are typically due to increased leakage of fluid secondary to raised intravascular pressure.[3] This is usually due to an underlying systemic illness such as cardiac failure or portal hypertension associated with liver cirrhosis. Hypo-proteinaemia results in reduced oncotic pressure and also causes a transudate, for example from a nephrotic syndrome or protein losing enteropathy. Conversely, an exudate represents protein rich fluid (protein > 25 g/L) formed secondary to haemorrhage, infection, inflammation or neoplasia.[3]

US can provide a non-invasive, qualitative assessment of the nature of the fluid. Transudates typically have homogenous, anechoic fluid with deep posterior acoustic enhancement (Figure 1).[4] Exudates demonstrate intrinsic complexity and may have features such as low level echoes, particulate debris and septations (Figure 2(a)).[2] US is more sensitive at demonstrating the internal complex features associated with an exudate when compared to CT,[1,2] which often only shows a bland 'grey' hypo-dense fluid attenuation (Figure 2(b)). The US findings between transudate and exudate may, however, overlap, hence sampling the fluid with a diagnostic paracentesis is considered to be the gold standard in differentiating between the two.[2] US can be used to safely target the relevant fluid component using an aseptic technique and minimise risk of visceral injury from the traditional 'blind' procedure carried out on the ward. Based on both quantitative and qualitative assessment, a decision can also be made confidently whether to proceed to percutaneous drain insertion.[1]

Ascites may be resultant from an intra-abdominal source, for instance tumour or an inflammatory aetiology, and also may be an important sign of a systemic illness, for example, cardiac or liver failure.[2] Therefore, the demonstration of ascites on US and initial judgement of the nature of the fluid should initiate a more focused interrogation of the peritoneal cavity, with all efforts made to provide a clinical explanation. US also serves to triage patients who may benefit from further cross sectional imaging with CT or magnetic resonance imaging (MRI) and most often, the diagnosis requires correlation of the radiological findings with the clinical picture.

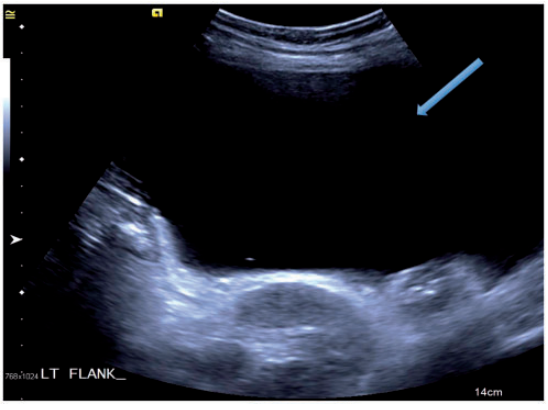

Figure 1. Sagittal US image through the left flank: This demonstrates a large volume of anechoic fluid (arrow) typical of a transudate. Note large volume of ascites displacing the left kidney allowing for a subjective quantification of the fluid by US. Patient was known to have liver cirrhosis.

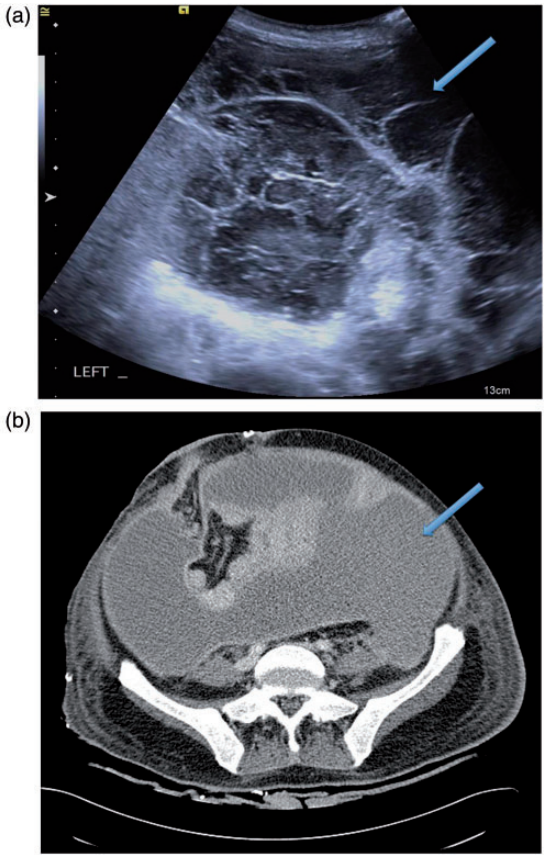

Figure 2. (a) An axial US image through the abdomen demonstrating complex ascites (arrow). Particulate debris and internal septations are a feature of exudates. Note qualitative role of US. (b) Contrast-enhanced axial CT image: Corresponding CT image in same patient showing a bland, homogenous low attenuation of fluid (arrow) on CT. Note US superiority at showing the complex nature of ascites.[1,2]

This pictorial review demonstrates a wide range of pathologies associated with the discovery of ascites, highlighting the varying appearances of the fluid and the pertinent points when fluid is encountered.

Technique

Ascites can be detected on physical examination using traditional shifting dullness to percussion when there is approximately 500 ml of fluid.[1,2] However, in an increasingly obese population, there is limited reliability on clinical examination findings alone. Trans-abdominal US (TAUS) can easily demonstrate large volumes of fluid and, with a meticulous technique, much smaller volumes can also be detected.[2]

The initial part of the US study includes a routine assessment of the abdominal and pelvic viscera using a standard sector transducer (5 to 7 MHz probe). There is a trade-off between the frequency of the probe and the depth of penetration required. This principle is fundamental in all applications of US. In patients with a high body mass index (BMI), reducing the frequency to enable greater depth of penetration will help increase visibility but at the expense of spatial resolution. Turning off tissue harmonic imaging may also be beneficial as it allows for greater depth of penetration.[5] Correct positioning of the focal zone is an important basic principle that will help to optimise the image further by improving lateral resolution at the region of interest.[5] In slim-built patients, additional assessment using a linear high frequency probe can provide greater intrinsic detail of the organ of interest, overlying peritoneum and the nature of fluid, and may highlight subtle complex features with greater clarity.

In the assessment of ascites, it is useful to start the study with a wide field of view.[2] This will help provide a global overview of the abdomen and pelvis and allow the operator to obtain a clinical perspective regarding the volume and distribution of fluid. With the patient in a supine position, ascites typically accumulates in the dependant portions of the abdominal cavity, typically in Morison's pouch (hepato-renal fossa) (Figure 3), pouch of Douglas (POD; recto-uterine pouch) (Figure 4) and para-colic gutters.[6] Free fluid usually insinuates the normal contours of the organs and conforms to the peritoneal folds. Fluid can become

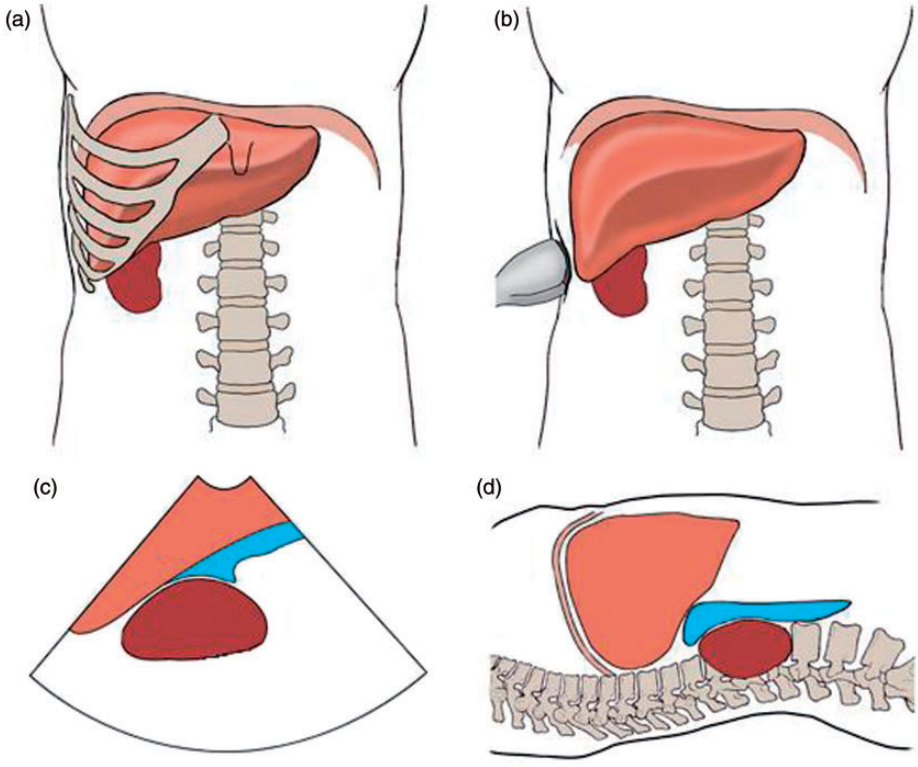

Figure 3. Illustration of Morison's Pouch: (a) anatomical illustration of the liver and right kidney; (b) Ideal transducer position for assessment of Morison's pouch; (c) Representative US image of (b) in which the ascites is seen as blue; (d) Illustration of how the ascites accumulates in Morison's pouch in a supine patient.

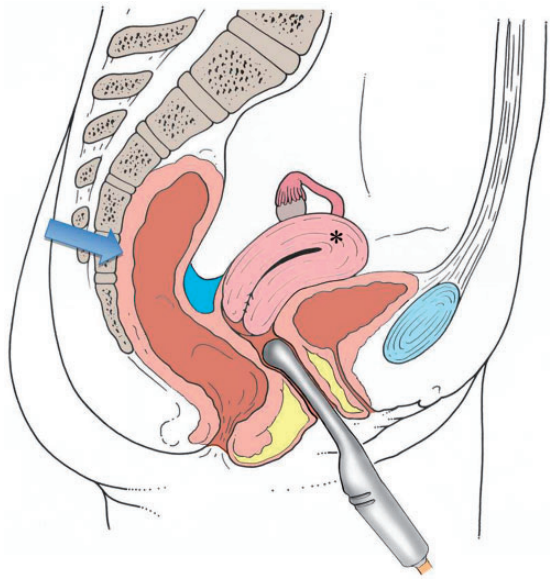

Figure 4. Illustration of ascites in the recto-uterine pouch (POD) in relation to the trans-vaginal transducer (rectum = arrow; uterus = *)

loculated when confined by adhesions, malignancy or infection. Loculated ascites may become encapsulated and form a collection. This can potentially exert a localized mass effect.[1]

The ability to assess the patient in different positions is an inherent strength of US and lets the operator scrutinise these dependant areas closely. For instance, assessment of Morison's pouch in the left lateral decubitus position may help draw attention to a small slither of fluid. Fluid can also track into the sub-phrenic space, which is also better assessed in the lateral decubitus position and on arrested inspiration. The dynamic nature of US also allows for the detection of loculated pockets of fluid.

In female patients, trans-vaginal US (TVUS) can identify tiny volumes of free pelvic fluid as small as 0.8 ml.[7] TVUS should be considered mandatory in the assessment of acute gynaecological conditions and also in suspected pelvic malignancy. TVUS provides detail of the uterus and adnexa that is often obscured or limited on TAUS. TVUS can interrogate the POD for small volumes of free fluid and provide a detailed assessment of the pelvic peritoneum, which may be the earliest indicator of underlying peritoneal disease.[1] A trace of free fluid in the recto-uterine pouch can be a normal physiological finding in asymptomatic females of a reproductive age.[1,8] This is typically seen in the peri-ovulatory phase following rupture of a dominant follicle. This fluid is simple, anechoic and limited to the POD.[8]

When assessing diffuse liver disease and associated ascites, pulse wave (PW) and colour Doppler assessment of the portal vein is important to complete the assessment of the vascular supply. The waveform pattern and velocity on PW Doppler alongside the direction of colour flow on Doppler assessment can detect the presence of underlying portal hypertension. The abnormal patterns seen on Doppler imaging is a useful adjunct that will support the diagnosis of portal hypertension in patients with ascites and suspected underlying chronic liver disease.

In the emergency setting, a sliver of free fluid in the dependent aspect of the upper abdomen (typically Morison's pouch) is sufficient to alert the clinician to an acute peritoneal process. In the acute scenario, US is a quick and easily accessible modality for clinical triage and can determine patients who will benefit from further cross sectional imaging. The detection of free fluid or haemoperitoneum has been the rationale for performing a focused assessment with sonography in the trauma setting (FAST scan), whereby the dependent regions of the supine patient's abdomen are specifically scrutinised for free fluid.[9–13] Fluid detected in this setting strongly suggests significant intra-abdominal injury with patients often requiring emergency laparotomy.[1]

Case 1 – Trace of ascites

A 45-year-old female presented to accident and emergency (A+E) with acute severe right upper quadrant (RUQ) pain. Initial plain film assessment performed in the A+E department did not demonstrate any free intra-peritoneal gas. Following clinical examination by the surgical team, an urgent US was requested to confirm a working diagnosis of acute cholecystitis.

US demonstrated a normal gallbladder and excluded gallstones (Figure 5(a)). The biliary tree and solid intra-abdominal organs were unremarkable. At the time of the US, there was significant localised peritonism in the RUQ. A trace of free fluid was demonstrated in Morison's pouch (Figure 5(b)). No other significant free fluid was demonstrated in the peritoneal cavity. In the clinical context, the radiological diagnosis was a suspected bowel perforation and the patient underwent an immediate contrast-enhanced CT scan. This demonstrated a perforated duodenal diverticulum (Figure 5(c)).

Detection of this small volume of free fluid, in the acute setting, was a strong indicator for underlying localized peritonitis. This free fluid was the only abnormal finding on US. Hence, its identification allowed for the rapid triage to CT, which confirmed the diagnosis and site of a bowel perforation. This timely imaging ensured that the patient was appropriately and promptly referred to the surgical team. Had the fluid gone undetected or overlooked, there might have been a significant delay in the diagnosis resulting in unwanted morbidity.

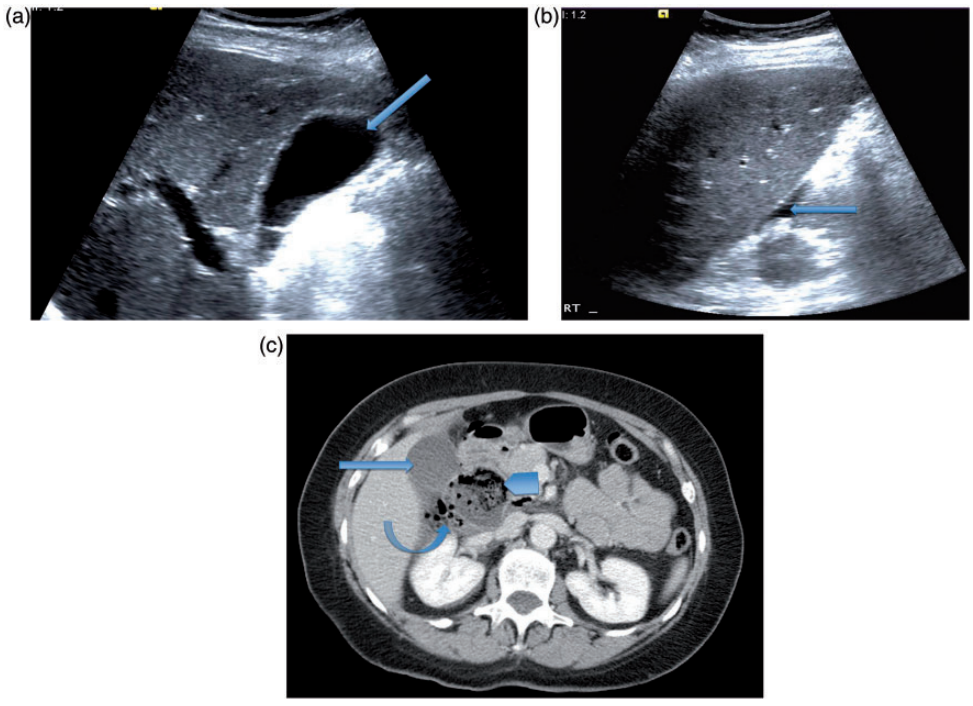

Figure 5. (a) Normal US appearances of the gallbladder (arrow) (b) US of RUQ demonstrating a trace of free fluid in Morrison's pouch (arrow) (c) Contrast-enhanced CT scan of the abdomen illustrating a perforated duodenal diverticulum containing a bezoar (arrowhead), a normal gallbladder (arrow) and free fluid in Morison's pouch with extra-luminal pockets of gas (curved arrow).

Learning point

In the acute setting, a trace of fluid in the upper abdomen is an abnormal finding and may be the only clue for an underlying acute abdomen.

Case 2 – Ascites from systemic condition

A 65-year-old male presented with RUQ pain, atrial fibrillation and deranged liver function tests (LFTs). An US was requested to investigate the elevated LFTs and RUQ pain. US showed a moderate volume of transudative ascites in the upper abdomen surrounding the liver and in Morison's pouch (Figure 6(a)). The liver had a subtle lobulated outline (Figure 6(a)) indicating the presence of chronic liver disease and dilated hepatic veins (Figure 6(b)). A contracted gallbladder with a thickened and oedematous wall (Figure 6(c)) was identified containing no gallstones. The biliary tree and the rest of the abdominal viscera were normal. Colour and PW Doppler assessment showed hepato-fugal flow within the portal vein and a pulsatile venous waveform (Figure 6(d)).

In the clinical context, the RUQ pain was attributed to hepatic congestion stretching the liver capsule. The derangement of LFTs and gallbladder wall oedema represents the sequela of chronic hepatic congestion secondary to underlying congestive cardiac failure (CCF). Doppler assessment of the portal vein demonstrated reversal of flow secondary to portal hypertension and a pulsatile PW Doppler signal indicating significant tricuspid regurgitation due to underlying right-sided cardiac failure. Review of serial chest X-rays demonstrated an improving clinical picture of heart failure following diuretic therapy.

Learning points

1. Ascites may be due to systemic illness from cardiac, hepatic and renal de-compensation.
2. Understand the importance of recognising patterns of disease to determine the cause: dilated hepatic veins and Doppler signal changes point to a cardiogenic cause.
3. The mural oedema in the gallbladder wall is a potential pitfall for acute cholecystitis.

Case 3 – Exudative ascites

A 40-year-old female with a known pelvic dermoid cyst underwent a planned laparoscopic cystectomy. At surgery, during retrieval of the cyst, the dermoid cyst

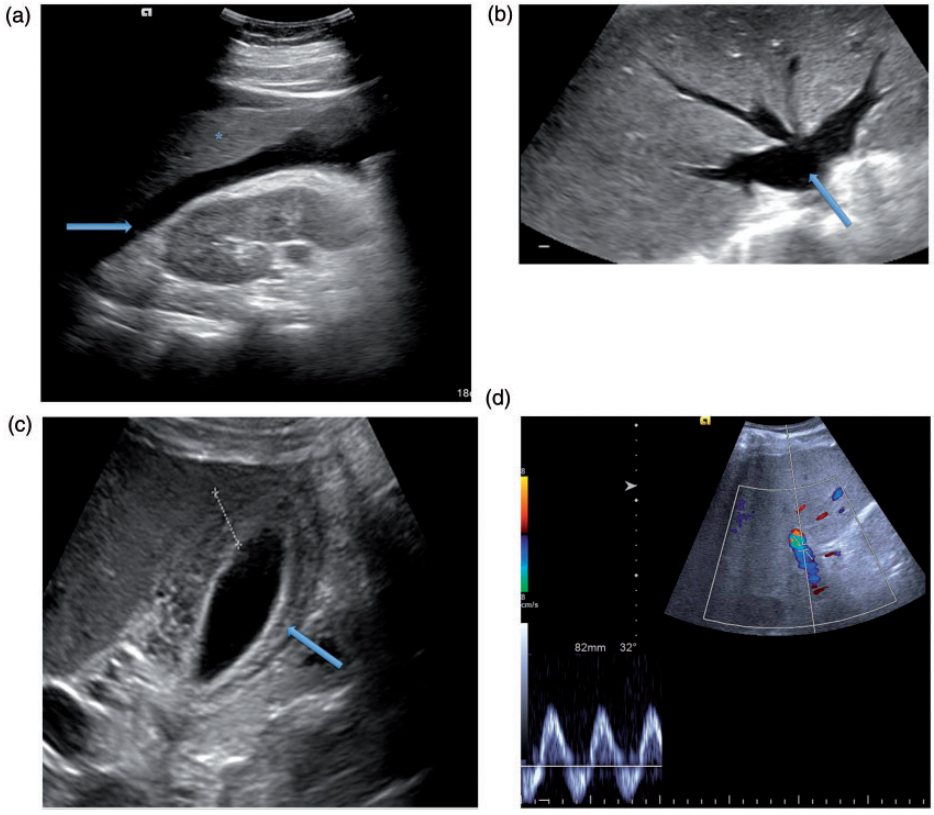

Figure 6. (a) An oblique section through the RUQ showing peri-hepatic simple ascites (arrow). Note the lobulated outline of the liver secondary to cardiac cirrhosis (*). (b) A transverse section through the liver demonstrating dilated hepatic veins at the confluence of the inferior vena cava (IVC) (arrow). (c) A longitudinal section through the RUQ showing a thickened, oedematous gallbladder wall (arrow). (d) A PW and colour Doppler trace taken of the portal vein demonstrates reversed and pulsatile flow.

ruptured causing spillage of cyst content into the peritoneal cavity.

Four days post-surgery, the patient underwent a CT scan due to increasing abdominal discomfort. The CT scan demonstrated ascites distributed beneath the abdominal wall with surrounding rim enhancement of the peritoneal layers (Figure 7(a)). The rim enhancement was thought to be an inflammatory response due to the chemical peritonitis and recent post-operative state. Given raised inflammatory markers on post-operative blood tests, percutaneous drainage was requested by the surgical team. An 8 French locking pigtail catheter was inserted while the patient was in the CT scanner. Despite the drain being correctly positioned within the fluid, only a trace of straw-coloured serous fluid was retrieved.

The procedure was uncomplicated, however, the patient continued to experience worsening pain post-procedure. An US was subsequently performed which demonstrated complex, septated ascites containing a small amount of fluid layered between the septations (Figure 7(b)). Due to the patient's pain and absence of infected fluid, the drain was removed. The US finding of only a small amount of potentially drainable fluid could have avoided the need for a percutaneous drain and unnecessary morbidity. The internal complex features were attributed to an underlying chemical peritonitis secondary to spillage of dermoid cyst content. The patient underwent subsequent laparotomy and required complex peritoneal surgery and omentectomy. Histology confirmed a xantho-granulomatous peritonitis.

Learning points

1. US is superior to CT when characterising and demonstrating the internal complex nature of fluid.
2. US-guided intervention to target fluid for sampling or drainage is safe and reliable.

Case 4 – Ascites and pneumoperitoneum

An 85-year-old man, with limited available clinical history, presented to A+E out of hours with worsening abdominal pain for a week. Laboratory tests showed an

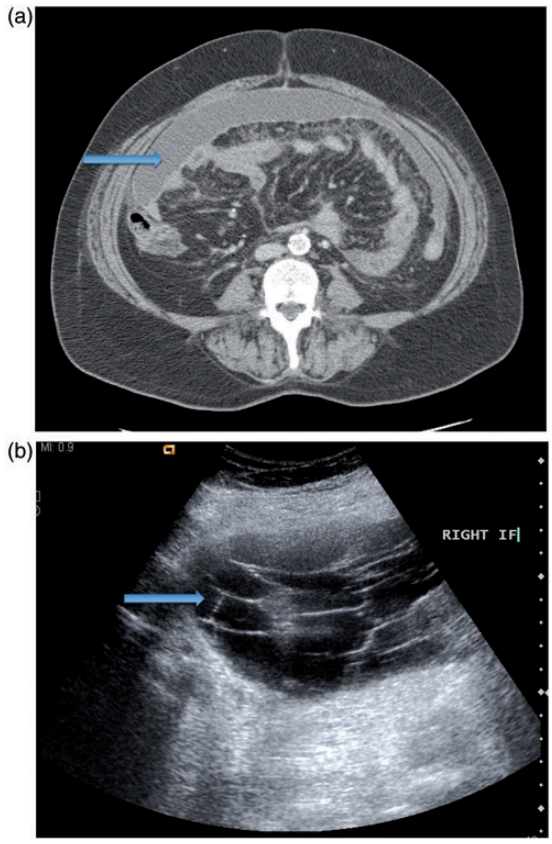

Figure 7. (a) Contrast-enhanced CT scan: Transverse section through the abdomen demonstrating ascites loculated beneath the abdominal wall (arrow). (b) US of the right iliac fossa (RIF) demonstrates complex ascites (arrow). Multiple septations are noted throughout the fluid suggestive of an exudate.

acute kidney injury, raised white cell count and significant elevated inflammatory markers. An initial plain CT scan without oral and intravenous contrast was performed on-call. The scan showed a small volume of generalised free fluid but no further specific focal abnormality or diagnosis (Figure 8(a)).

Given increasing pain, an US scan was requested the next morning by the surgical team. US demonstrated an increased volume of complex ascites with internal septa and debris and thickened matted small bowel loops (Figure 8(b)). There was co-existent peritonism during the assessment. Crucially, there were multiple linear arcs of hyper-echoic foci within the fluid with a characteristic posterior reverberation artefact in the non-dependant aspect of the fluid (Figure 8(c)). Speckled hyper-echoic foci were also freely seen in the fluid (Figure 8(d)). Appearances were characteristic of free intra-peritoneal gas. The patient underwent a laparotomy, which confirmed a perforated gastric ulcer.

On review of the CT, the fluid had a uniform low density (HU20) indicating relatively simple fluid and there was no free intra-peritoneal gas present on the scan. The presence of free intra-peritoneal gas was first demonstrated on the subsequent US. In conjunction with the clinical signs of peritonism and the US findings, the diagnosis of bowel perforation was made. This case illustrates the superiority of US over CT in the depiction of the complex nature of fluid and highlights the importance of recognizing abnormal extraluminal gas locules on US.

Learning point

Gas is mobile and highly reflective on US. In conjunction with ascites, it can indicate bowel perforation or sepsis.

Case 5 – Haemoperitoneum

A 25-year-old female presents with acute RIF pain and localised peritonism. Last menstrual period (LMP) was six weeks ago and a urine pregnancy test was positive. The clinical diagnosis was a likely ruptured ectopic pregnancy.

TVUS demonstrated an empty uterus and a 'pseudomass' in the POD in keeping with blood clot (Figure 9(a)). On examination of the right adnexa, an extra-uterine gestation sac was identified immediately medial to the right ovary containing a yolk sac (Figure 9(b)). Further assessment of the right adnexa showed complex pelvic ascites (Figure 9(c)). The fluid contained low level echoes and in the clinical context, appearances were consistent with a haemoperitoneum. The close proximity of the trans-vaginal probe and increased spatial resolution allowed for clear visibility of the empty uterus and confidently allowed the diagnosis of a ruptured right adnexal ectopic pregnancy to be made. The patient underwent emergency laparoscopic surgery.

Learning point

Haemorrhage can have varied appearances in US. The clue to the underlying diagnosis is in the clinical history.

Case 6 – Peritoneal carcinomatosis

A 70-year-old male presented with vague abdominal pain and bloating and no other significant medical history. US demonstrated no focal abnormality in the solid intra-abdominal organs and normal hepatopetal flow in the portal vein. US demonstrated a moderate volume of ascites, which showed low level echoes and particulate debris (Figure 10(a)). No peritonism was identified. Further interrogation of the peritoneal cavity demonstrated an omental cake (Figure 10(b) and (c)). The appearances were consistent with metastatic omental disease.

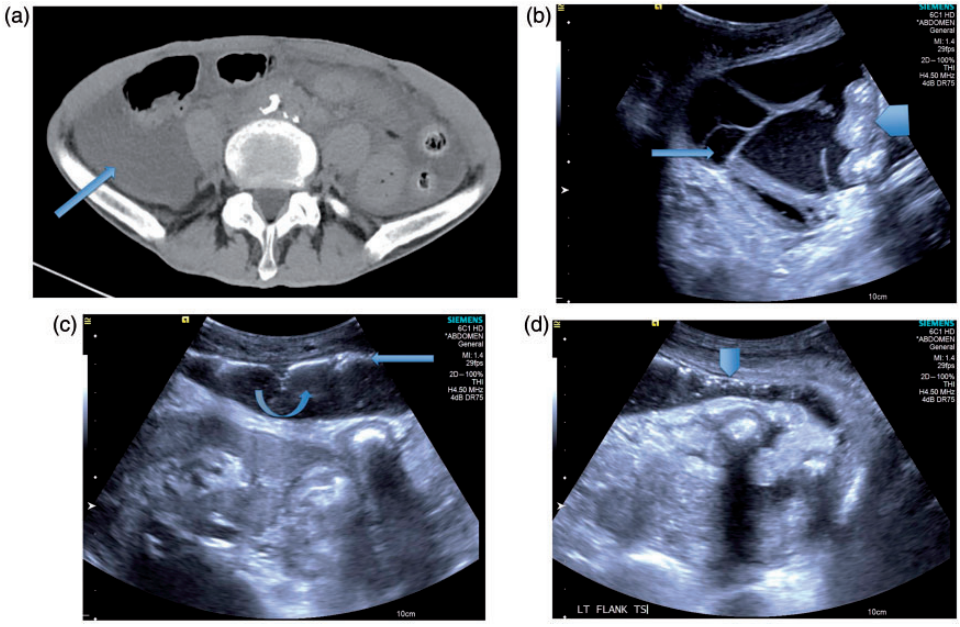

Figure 8. (a) CT scan. Generalised ascites noted (arrow) but no free gas. (b) US scan. Complex fluid with internal septations and low level echoes (arrow) indicative of an exudate. Arrowhead points to matted bowel loops. (c and d) Linear hyper-echoic arcs (arrow) with posterior reverberation artefact (curved arrow) and mottled specks of hyper-echoic foci (arrowhead) in the non-dependant aspect beneath the abdominal wall correspond to pneumoperitoneum.

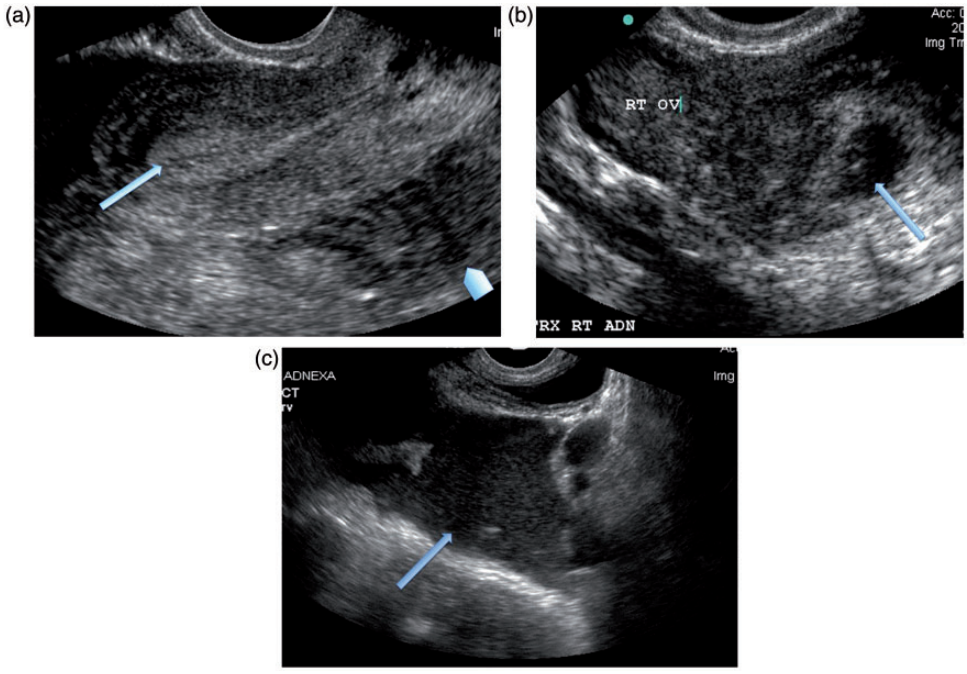

Figure 9. (a) TVUS of an anteverted uterus with no evidence of an intrauterine gestation sac (arrow). Note the solid heterogeneous material in the POD in keeping with a haematoma (arrowhead) (b) Extra-uterine gestation sac seen medial to the right ovary (arrow) (c) Complex pelvic ascites (arrow) suggestive of haemoperitoneum.

The patient subsequently underwent a full body staging CT scan, which did not reveal an underlying primary lesion. The CT scan confirmed the presence of ascites and omental caking. Subsequent upper and lower gastrointestinal endoscopy was also negative. An omental biopsy was performed under US guidance

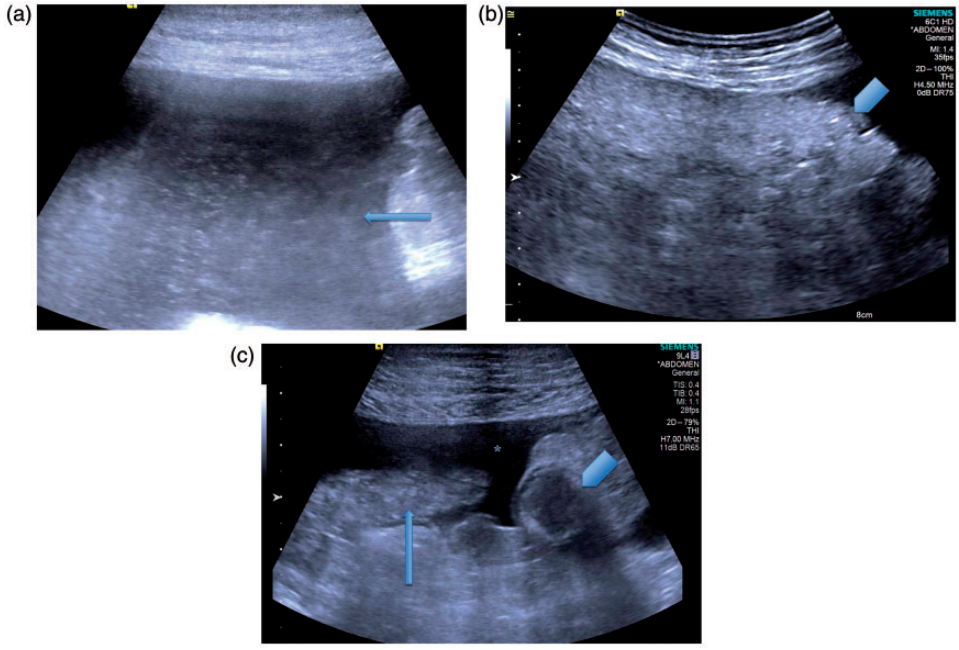

Figure 10. (a) US of the abdomen demonstrated particulate ascites in keeping with an exudate (arrow) (b) A hyper-echoic omental cake in the expected position of the greater omentum (arrowhead) (c) Floating omental cake (arrow) bathed by ascites (*). This is clearly separate from adjacent bowel loops (arrowhead).

and a metastatic adenocarcinoma was diagnosed histologically.

Learning point

The detection of particulate ascites is a significant finding and requires thorough assessment to determine the cause, which can include an underlying malignancy.

Discussion

Ascites is a relatively common finding encountered in one or more patients on most US lists, in particular within hospitals providing US in the emergency setting. Recognising this important sign on US, alongside correct interpretation in the appropriate clinical context is vital to ensure the accurate management of patients. This series of cases shows how the detection and characterisation of ascites on US are central in making crucial clinical decisions with regard to guiding the need and timing of further imaging, therapeutic radiological intervention and emergency surgery. Each case provides a salient point pertaining to the recognition and characterisation of ascites on US.

Case 1 demonstrates the pivotal role of US in the detection of a small volume of fluid, which was the only marker of a surgical acute abdomen necessitating urgent surgery, in this case, due to a perforated duodenal diverticulum. US serves as a robust triage tool and can expedite diagnosis and definitive management.

Case 2 shows the importance of appreciating the pathophysiology of ascites. In this case, ascites is a transudate and a reflection of CCF. CCF results in an increased intravascular back-pressure within the hepatic and portal venous system.[14] This accounts for the dilated hepatic veins and hepato-fugal flow in the portal vein on Doppler assessment. Chronic elevated intravascular pressure leads to progressive irreversible sinusoidal stasis and chronic liver damage,[14] sometimes referred to as cardiac cirrhosis.

The layered thickening of the gallbladder wall represents mural oedema secondary to CCF. This should not be mistaken for an acute cholecystitis. The absence of gallstones and a non-distended state are further clues. The gallbladder wall oedema and ascites usually reverse once the CCF is treated medically. Paracentesis was not required in this patient.

Case 3 highlights the superiority of US over CT in the characterisation of the internal features of fluid. This is an important principle that can be applied in the assessment of cystic lesions, fluid filled structures and collections demonstrated on CT. In this case, CT was unable to demonstrate the internal complexity of the ascites, which led to unnecessary percutaneous drain insertion. Subsequent US was able to readily demonstrate the internal septa and lack of drainable fluid.

The presence of internal complex features, such as septations, is not necessarily an absolute contraindication for percutaneous drainage. When fluid demonstrates these internal complex features, the decision to

proceed to aspiration or drain insertion is often made following discussion with the clinical team taking into account the strong consideration of the clinical picture. Sampling the fluid alone may often be sufficient to determine the nature of the fluid, which can guide further management and direct the need for percutaneous drainage. Differentiation between exudative ascites on US due to peritonitis from infection, inflammation and other unusual causes such as urine, pancreatic fluid or bile is challenging. The clinical history will provide strong clues; however, ultimately a diagnostic paracentesis will be required.

Case 4 highlights that careful assessment of the nature of fluid and application of the fundamental principles, allows for the detection of pneumoperitoneum. Gas can be seen as linear hyper-echoic foci that cast a posterior ring down or reverberation artefact.[5] This is typically found in the non-dependant aspects of the fluid. These streaks of gas are mobile and can be seen to move when transferred from supine to lateral decubitus position. This appearance is also seen in the detection of gas in fluid collections, abscess or underlying peritonitis. US enables the operator to detect useful abdominal signs of peritonitis, such as rebound tenderness and guarding that add weight to the sonographic findings.

US is not regarded as the primary imaging modality in the assessment for pneumoperitoneum. CT is regarded as the gold-standard test for the demonstration of gas outside the bowel lumen. However, given US is being used for a broad range of clinical scenarios as the initial imaging modality, there is potentially an opportunity to detect this extremely important finding. In the appropriate clinical setting, free intra-peritoneal gas is an indication of bowel perforation and the cause should be urgently investigated.

There are many potential causes of haemoperitoneum including trauma, aneurysm rupture, ruptured ectopic pregnancy or liver mass, iatrogenic and over anti-coagulation.[1,2] The US appearances of haemoperitoneum are varied and dependent on the timing, duration and degree of haemorrhage.[1,2] In the acute phase, haemorrhage is often anechoic and may or may not contain particulate matter. With organisation of the blood product, layering may develop likened to the haematocrit effect usually observed when the patient is immobile. There is typically evidence of linear septations, which may have a lace-like and reticular appearance. If haemorrhage is significant, a large clot may be seen. This is often heterogeneous, usually hyper-echoic and can have a worrying mass like appearance. Blood clot can misleadingly be interpreted as a neoplastic mass on both US and CT.[2] Doppler assessment on US is important to exclude any internal vascularity to aid in the differentiation between an underlying focal lesion and clot. Clinically, a corresponding drop in haemoglobin often assists in making the diagnosis.

In case 5, the clinical history is classical for a ruptured ectopic pregnancy. TVUS can demonstrate the early features of patients with ectopic pregnancy and highlight associated complications.

The presence of complex particulate ascites, as demonstrated in case 6, is an alarming finding particularly in the outpatient setting, as it may indicate underlying malignancy. Careful scrutiny of the solid organs and the peritoneum is imperative to look for ancillary findings of intra-abdominal malignancy.

In this case, the patient had normal solid intra-abdominal organs but omental caking was present which represents infiltration of the greater omentum with peritoneal carcinomatosis (PC). The particulate ascites is due to the cellular nature of the fluid. Separating benign from malignant ascites is not possible from characterisation of the fluid alone and diagnostic paracentesis is the gold-standard for cytological evaluation.[2] Only with careful inspection can omental cake be detected on US, as this may easily be overlooked and quickly mistaken for a bowel loop. Meticulous technique is needed to assess the near field and with a high frequency linear transducer, the sensitivity for detection of omental caking can be increased. The identification of peritoneal disease on US warrants further assessment with CT to determine the primary aetiology.

Conclusion

US provides excellent qualitative information and can safely provide a subjective quantitative measure of the volume of fluid. US is therefore a reliable first-line imaging modality and is useful for clinical triage, directing appropriate patient management and determining the need for timely intervention. Once ascites is demonstrated, all efforts must be made to account for this important finding. This may be the only clue to indicate significant abdominal, peritoneal pathology or an underlying systemic illness.

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Guarantor

CF.

Contributors

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